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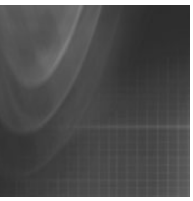

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Purpose

The purpose of this study is to investigate the racial/ethnic disparities in health-related quality of life (HRQOL) among adults with self-reported diabetes and identify the different risk factors related to HRQOL for specific racial/ethnic groups in the United States.

Methods

National Health and Nutrition Examination Survey (NHANES) 2001-2010 participants (ages 20 years and older) who were self-identified as non-Hispanic white, non-Hispanic black, or Hispanic and with self-reported diabetes were included in the analysis (n = 2594). The Centers for Disease Control and Prevention's HRQOL-4 was used to assess factors associated with HRQOL through multivariate logistic regression models with survey weighting. Stepwise model selection was applied to select the most significant factors for HRQOL in each racial/ethnic group.

Results

Hispanic participants were less likely to report 14 or more mentally unhealthy days and activity-limited days compared to non-Hispanic white counterparts, adjusting for age, sex, education, marital status, family poverty–income ratio (PIR), body mass index, smoking status,

insurance coverage, and diabetes duration. Current smoking status and obesity were significantly associated with worse HRQOL among whites and blacks. Marital status predicted better HRQOL only among Hispanics. Having insurance coverage predicted better HRQOL among both blacks and Hispanics. Increased family PIR had a favorable association with the 4 HRQOL domains consistently among all races/ethnicities.

Conclusion

Minimal racial/ethnic disparities in HRQOL were observed among US adults with self-reported diabetes. Support is offered for more individualized health care and communication with patients to target care and interventions that improve health and quality-of-life indicators.

Introduction

Diabetes continues to be a serious and growing public health concern that conveys substantial morbidity and mortality in the United States and worldwide. Between 1990 and 2001, the prevalence of diagnosed diabetes in the United States rose from 4.9% to 7.9%, a 61% increase.[1,2] In 2010, 25.8 million, or 8.3%, of the US population had diabetes,[3] and the number of Americans with diagnosed diabetes was projected to increase to 29 million by 2050.[4] The disparities associated with diabetes are another public health concern, as its incidence, prevalence, and mortality rate are much higher among minorities than among whites.[3]

Health-related quality of life (HRQOL), defined as an individual's or group's self-perception of physical and mental health,[5] is increasingly used to assess the effect of chronic diseases and their treatments rather than solely using objective measurements (ie, morbidity and mortality).[6,7] Accordingly, future health care policy for many conditions may depend more heavily on HRQOL indicators than on measures based on counts of illness occurrence or survival time. Healthy People 2020 has identified quality-of-life improvement as a central public health goal.[8] Furthermore, the Centers for Medicare & Medicaid Services selected HRQOL as the primary outcome measure for evaluating managed care delivery programs.[9]

Recent research has shown that diabetes is associated with worse HRQOL,[6,10-12] but the racial/ethnic disparities in HRQOL among diabetic patients are less understood. Only 2 studies have apparently examined the potential racial disparities in diabetic patients' HRQOL.[13,14] However, these 2 studies included only older patients (age ≥ 65 years) from a single state and yielded inconsistent results. One study found worse HRQOL among Native American patients compared to their white counterparts.[13] The other study found better physical health for minorities compared to their white counterparts.[14] The inconsistent findings from the previous studies support the need for additional studies with a more generalizable sample and broader age range. The objective of this study was to investigate whether racial/ethnic disparities in HRQOL exist among US adults with self-reported diabetes. This study also aimed to identify the key elements that influence HRQOL in specific racial/ethnic groups to help researchers and policy makers identify tailored interventions for diabetic patients of different races/ethnicities, which could provide another important step toward eliminating health-related racial disparities.

Methods

Study Participants (NHANES 2001-2010)

The National Health and Nutrition Examination Survey (NHANES) is a program designed to assess the health and nutritional status of adults and children in the United States. The NHANES participants are sampled to be representative of the US resident, noninstitutional population and oversampled for minorities, to ensure adequate sample size for evaluation of the subgroups. Instead of a simple random sample, a complex, multistage, probability sampling design is used to select participants for NHANES. The sampling procedure consists of 4 stages, moving from counties to segments, households, and finally individuals. Each sampled person is assigned a numerical sample weight, which accounts for the number of people in a specific age, sex, and race/ethnicity category represented by the particular sampled person.[15] The sample weights incorporate adjustment for unequal selection probabilities and certain types of nonresponse.[15] Since 1999, the data collection is ongoing and new datasets are released every 2 years for public use. Details of the NHANES design and procedures are available on the Centers for Disease Control and Prevention (CDC) website and previous publications.[15] In brief, NHANES 2001-2010 includes 5 cross-sectional surveys of the noninstitutionalized US population.

There were 3047 participants ages 20 years and older with self-reported diabetes from NHANES 2001-2010. The final sample size for the study was 2594 with self-reported race/ethnicity of non-Hispanic white, non-Hispanic black, Mexican American, or other Hispanic after excluding 127 participants with other race/ethnicity (including multiracial) and 326 participants who did not have any information on the 4 domains of HRQOL. Mexican American and other Hispanics were combined into a single Hispanic group in the analysis. Self-reported diabetes was identified when the participants answered "yes" to the question, "Have you ever been told by a doctor or health professional that you have diabetes or sugar diabetes?"

CDC HRQOL-4 Core Questions

Health-related quality of life was measured with a 4-item set of HRQOL questions developed by the CDC (CDC HRQOL-4), which is designed for population surveillance and has demonstrated good validity and reliability.[16-20] In the mid-1990s, the CDC supported several studies to evaluate the validity of CDC HRQOL measurements in various populations, and good construct validity has been found in different general noninstitutionalized adult populations, including ones in Canada and Puerto Rico.[17,18] High and consistent correlations of CDC HRQOL measurements with other HRQOL measurements, such as the Medical Outcomes Survey Short Form 36 (SF-36), in a general community and a population of persons with known disabilities, have confirmed its good validity.[19] The CDC HRQOL-4 has also been reported to validly distinguish the persons with increased age, disability, or chronic diseases from the general population.[10-12,16-17] In addition, it showed high test–retest reliability (with Kappa statistics—a conservative measure of agreement beyond that expected by chance on a 0 to 1 scale—ranging from 0.57 to 0.75 for the 4 questions) in a survey of 868 Missouri residents.[20] CDC HRQOL-4 is useful for finding unmet health needs, identifying disparities among demographic and socioeconomic subpopulations, characterizing the symptom burden of disabilities and chronic diseases, and tracking population patterns and trends.[16]

The CDC HRQOL-4 has 4 core questions, including 1 question about self-rated health status and 3 questions about the number of unhealthy days during the past 30 days. They are (1) "Would you say that in general your health is excellent, very good, good, fair, or poor?"; (2) "Now thinking about your physical health, which includes physical illness and injury, how many days during the past 30 days was your physical health not good?"; (3) "Now thinking about your mental health, which includes stress, depression, and problems with emotions, how many days during the past 30 days was your mental health not good?"; and (4) "During the past 30 days, approximately how many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation?" The answer to the first question includes 5 categories, from excellent to poor; the answers to the last 3 questions are the number of days, ranging from 0 to 30. The HRQOL-4 question responses were categorized according to the CDC's recommended cut points in the current study. Self-rated health status was dichotomized into poor to fair and good to excellent, whereas the answers involving unhealthy days were dichotomized as 14 or more days and less than 14 days, because of the skewed distributions of the HRQOL variables.[5]

Covariates

The covariates investigated in the current analysis were chosen based on a review of the literature of risk factors for the HRQOL of diabetic patients and the covariates available in the NHANES dataset.[10-12,21-23] Variables adjusted for included race, age, sex, education, marital status, family poverty–income ratio (PIR), body mass index (BMI), smoking status, insurance coverage, and diabetes duration. Information on race, age, sex, education level, marital status, and insurance coverage were gathered via self-report, whereas BMI was measured in the mobile examination center by trained health technicians. Family PIR was calculated by dividing family income by the poverty guidelines, specific to family size, as well as the appropriate year and state. Smaller family PIR indicates lower family income level. Using the suggested cut points from the NHANES III Analytic and Reporting Guidelines,[24] individuals with family PIR less than 1.3 were set as the reference group, compared with those with family PIR between 1.3 and 3.5 as well as those with PIR greater than 3.5. Never-smoker was the reference group and was defined as having smoked less than 100 cigarettes. Current smoker was defined as ever having smoked at least 100 cigarettes and now smoking every day or some days, and former smoker as ever having smoked at least 100 cigarettes and not smoking now. Diabetes duration was calculated from the participants' age at interview subtracted by age at diagnosis of diabetes and categorized into 4 groups: less than or equal to 5 years, 6 to 10 years, 11 to 20 years, and more

than 20 years. In the analysis, every covariate was treated as a categorical variable in the multivariate logistic regression models.

Statistical Methods

Analysis of variance (ANOVA) and chi-square tests were used to compare the difference of the means of continuous variables and the difference of the frequency of categorical variables in the descriptive analyses. Logistic regression is the method most commonly used to model the association between a binary outcome variable and 1 or more explanatory variables. It estimates how much the odds of a particular outcome change for a given change in a specific factor. In the present study, univariate and multivariate logistic regression models were applied to estimate the odds ratio (OR) for race/ethnicity and other covariates. To identify the different determinants of HRQOL in each racial/ethnic group, the dataset was stratified by race/ethnicity and used the stepwise model selection method (with the *P* value for entry set at .15 and that for stay at .20) to select the predictors in each stratum. In the following stratified multivariate regressions, only the selected covariates were controlled for in the model.

To account for the complex survey design, the 2-year mobile examination center survey weight divided by 5 was employed to provide an appropriate 10-year survey weight for each participant. Primary sampling units and strata used by NHANES were also adjusted for in the descriptive analyses, as well as the univariate and multivariate regressions. Results of all statistical tests were considered as significant at P value $< .05$, but exact P values and confidence intervals (CIs) for the odds ratios are also provided to help further assess the statistical strength of the evidence. All analyses were conducted using SAS version 9.3 (SAS Institute, Inc, Cary, North Carolina, USA) statistical software.

Results

Descriptive Analyses

The mean age of 2594 adults with self-reported diabetes was 59.5 ± 0.4 years (62.6 ± 0.3 years, unweighted) and mean diabetes duration was 11.1 ± 0.3 years (12.1 ± 0.3 years, unweighted). Of them, 42.1% were non-Hispanic white, 27.3% non-Hispanic black, and 30.6% Hispanic (Table 1). Compared to non-Hispanic blacks and Hispanics, non-Hispanic white participants were older and had higher prevalence of college or above education level, family PIR greater than 3.5, and insurance coverage. Non-Hispanic blacks were less likely to have normal weight and to be married or living with a partner but more likely to be current smokers, compared to non-Hispanic whites and Hispanics.

The weighted frequency of the 4 domains of HRQOL is also shown in Table 1. The prevalence of poor to fair self-rated health status was much lower among non-Hispanic whites (39.0%) relative to non-Hispanic blacks (50.5%) and Hispanics (51.9%) ($P < .001$). In contrast, the frequency of the other 3 domains of unhealthy days did not significantly differ by race/ethnicity. The lowest prevalence of reporting 14 or more physically unhealthy days, mentally unhealthy days, and activity-limited days occurred among Hispanics (18.5%, 14.4%, and 8.9%, respectively).

Univariate and Multivariate Analyses

Non-Hispanic white was set as the reference group in both univariate and multivariate models. In univariate analyses, the crude odds ratios for self-rated health status were statistically significant for both non-Hispanic blacks (OR [95% CI] = 1.6 [1.2-2.1]) and Hispanics (OR [95% CI] = 1.7 [1.2-2.3]) (Table 2). However, non-Hispanic blacks did not have a statistically significant difference in any of the 4 domains of HRQOL compared to non-Hispanic whites after adjusting for age, sex, education, marital status, family PIR, BMI, smoking status, insurance coverage, and diabetes duration. Hispanic participants were less likely to report at least 14 mentally unhealthy or activity-limited days compared to their white counterparts (OR [95% CI] = 0.5 [0.3-0.8], 0.4 [0.3-0.7], respectively) in the multivariate analyses.

Stratified Analyses by Race/Ethnicity

Tables 3, 4, and 5 give the adjusted odds ratios of the most predictive model of the key characteristics for the 4 domains of HRQOL, for non-Hispanic whites, non-Hispanic blacks, and Hispanics, respectively. Stepwise model selection yielded different sets of key variables for the 4 domains of HRQOL for each race/ethnicity.

Among non-Hispanic white participants, age, family PIR, BMI, and smoking status were selected as the associated variables for all 4 domains of HRQOL (Table 3). Although increased family PIR is associated with significantly improved HRQOL across all 4 domains with a monotonic dose-response relationship, current smokers reported significantly worse HRQOL in the 4 domains

Table 1

Characteristics of the Participants with Self-Reported Diabetes Ages 20 Years and Older in National Health and Nutrition Examination Survey (NHANES) 2001-2010, for Total Population and by Race/Ethnicity (n = 2594)[a]

Characteristic	All Participants	Non-Hispanic White	Non-Hispanic Black	Hispanics
No. (%)[b]	2594 (100)	1092 (42.1)	708 (27.3)	794 (30.6)
Mean of age, year ± SE[b]	59.5 ± 0.4	61.2 ± 0.5	57.2 ± 0.5	54.6 ± 0.8
Mean of diabetes duration, year ± SE	11.1 ± 0.3	11.4 ± 0.4	10.8 ± 0.4	10.1 ± 0.5
Sex, %[b]				
Male	48.7	50.6	41.0	49.2
Female	51.3	49.4	59.0	51.8
Education, %[b]				
Less than high school	29.3	22.5	35.2	54.2
High school or equivalent	25.5	27.9	25.3	14.6
College or above	45.2	49.7	39.6	31.3
Marital status, %[b]				
Married/living with partner	61.7	65.0	48.4	62.3
Never married	7.9	6.1	12.6	10.4
Divorced/widowed/separated	30.5	29.0	38.9	27.2
Family poverty–income ratio, %[b]				
< 1.3	24.6	19.3	31.4	41.8
1.3-3.5	43.0	42.8	46.5	39.3
> 3.5	32.4	37.9	22.0	18.9
Body mass index, %[c]				
< 25	13.2	13.3	11.4	15.1
25-29.99	26.5	24.9	26.0	34.4
≥ 30	60.3	61.8	62.6	50.5
Smoking, %[b]				
Never-smoker	47.4	45.8	47.7	55.0
Former smoker	34.7	37.8	28.4	27.8
Current smoker	17.9	16.5	23.9	17.2
Insurance coverage, %[b]	89.4	93.7	87.1	71.6
Self-rated health, %[b]				
Good-excellent	57.1	61.0	49.5	48.1
Poor-fair	42.9	39.0	50.5	51.9
Physically unhealthy days, %				
< 14 days	78.7	79.0	75.3	81.5
≥ 14 days	21.3	21.0	24.7	18.5
Mentally unhealthy days, %				
< 14 days	83.8	83.8	82.3	85.6
≥ 14 days	16.2	16.2	17.7	14.4
Activity-limited days, %				
< 14 days	87.8	87.2	87.3	91.1
≥ 14 days	12.2	12.8	12.7	8.9

[a]Except for No. (%), all other results are weighted and presented as mean ± SE for continuous variables and percentage for categorical variables. Percentages may not sum to 100% due to rounding.
[b]$P < .001$.
[c]$P < .05$.

Table 2

Crude and Adjusted Odds Ratios (ORs) and 95% Confidence Intervals (CIs) of Race/Ethnicity for Health-Related Quality of Life (HRQOL) among Adults with Self-Reported Diabetes, National Health and Nutrition Examination Survey (NHANES) 2001-2010[a]

Characteristic	Health Status Fair/Poor OR (95% CI)	≥ 14 Physically Unhealthy Days OR (95% CI)	≥ 14 Mentally Unhealthy Days OR (95% CI)	≥ 14 Activity-Limited Days OR (95% CI)
Crude OR				
Non-Hispanic white	1	1	1	1
Non-Hispanic black	**1.6 (1.2-2.1)**	1.2 (0.9-1.6)	1.1 (0.8-1.5)	1.0 (0.7-1.5)
Hispanic	**1.7 (1.2-2.3)**	0.9 (0.6-1.2)	0.9 (0.6-1.3)	**0.7 (0.5-1.0)**
Adjusted OR[b]				
Non-Hispanic white	1	1	1	1
Non-Hispanic black	1.1 (0.8-1.5)	1.0 (0.7-1.4)	0.7 (0.5-1.0)	0.7 (0.6-1.1)
Hispanic	1.1 (0.8-1.6)	0.7 (0.5-1.1)	**0.5 (0.3-0.8)**	**0.4 (0.3-0.7)**

[a]All results are weighted. ORs in bold indicate statistical significance at $\alpha = 0.05$ level.
[b]Reflects adjustment for age, sex, education, marital status, family poverty–income ratio, body mass index, smoking, insurance coverage, and diabetes duration.

compared to never-smokers. Increased age was a protective factor for mental health (OR [95% CI] for at least 14 mentally unhealthy days, 65 years or older vs 20-49 years = 0.4 [0.2-0.6]) but an adverse factor for physical health. Participants ages 50 to 64 years had increased risk of poor to fair general health and more than 14 activity-limited days compared to participants ages 20 to 49 years old (OR [95% CI] = 2.2 [1.4-3.5], 2.3 [1.2-4.2], respectively). Female white participants had increased risk of reporting poor to fair general health and at least 14 mentally unhealthy days compared to their male counterparts (OR [95% CI] = 1.6 [1.2-2.2], 1.9 [1.3-2.9], respectively). Participants with a college or above degree were less likely, but those with more than 20 years diabetes duration were more likely, to report poor to fair self-perceived health status compared to their counterparts (OR [95% CI] = 0.5 [0.3-0.7], 2.1 [1.3-3.3], respectively).

Family PIR and smoking status had the same apparent effect on the 4 domains of HRQOL among non-Hispanic black participants (Table 4) as among the non-Hispanic whites. In addition, increased BMI, and especially being obese (BMI ≥ 30), significantly increased the risk of poor to fair health status and at least 14 physically unhealthy days (OR [95% CI] = 2.1 [1.3-3.6], 2.7 [1.4-5.4], respectively). In contrast to non-Hispanic white participants, the education level of high school or equivalent indicated a statistically significant protective influence for both poor to fair self-rated health status and at least 14 mentally unhealthy days (OR [95% CI] = 0.5 [0.4-0.8], 0.4 [0.2-0.7], respectively). Moreover, being without insurance coverage was a significant predictor of poor to fair self-rated health status among non-Hispanic blacks (OR [95% CI] = 2.1 [1.3-3.1]).

Family PIR results indicated a similar effect on HRQOL among Hispanics other than not being a key factor for physically unhealthy days. Smoking status and BMI were not selected as predictors of any HRQOL domain for Hispanics, however (Table 5). Furthermore, marital status indicated a consistent effect on physical and mental health among Hispanics, that is, compared to participants who were married or living with a partner, those never married were less likely to report at least 14 physically and mentally unhealthy days (OR [95% CI] = 0.5 [0.3-0.8], 0.4 [0.1-1.3], respectively), but those Hispanics who were divorced, widowed, or separated were more likely to report at least 14 physically and mentally unhealthy days (OR [95% CI] = 1.6 [1.0-2.4], 1.7 [1.1-2.7], respectively). Lacking insurance coverage was another important risk factor for poor to fair self-rated general health and at least 14 mentally unhealthy days among Hispanics (OR [95% CI] = 2.4 [1.5-3.8], 1.6 [1.1-2.6], respectively).

Table 3

Adjusted Odds Ratios (AORs) and 95% Confidence Intervals (CIs) for the Most Predictive Model[a] of Specific Health-Related Quality of Life Indices among Non-Hispanic White Adults with Self-Reported Diabetes, National Health and Nutrition Examination Survey (NHANES) 2001-2010[b]

Characteristic	Health Status Fair/Poor AOR (95% CI)	≥ 14 Physically Unhealthy Days AOR (95% CI)	≥ 14 Mentally Unhealthy Days AOR (95% CI)	≥ 14 Activity-Limited Days AOR (95% CI)
Age group, y				
20-49	1	1	1	1
50-64	**2.2 (1.4-3.5)**	**2.5 (1.4-4.5)**	0.8 (0.5-1.5)	**2.3 (1.2-4.2)**
≥ 65	1.1 (0.7-1.8)	**2.2 (1.3-3.7)**	**0.4 (0.2-0.6)**	1.1 (0.6-2.1)
Sex				
Male	1		1	
Female	**1.6 (1.2-2.2)**		**1.9 (1.3-2.9)**	
Education				
Less than high school	1	1		1
High school or equivalent	0.6 (0.4-1.0)	0.7 (0.4-1.2)		0.7 (0.4-1.2)
College or above	**0.5 (0.3-0.7)**	0.7 (0.4-1.2)		0.8 (0.5-1.3)
Family poverty–income ratio				
< 1.3	1	1	1	1
1.3-3.5	**0.5 (0.4-0.8)**	**0.5 (0.4-0.8)**	**0.5 (0.3-0.8)**	0.7 (0.5-1.1)
> 3.5	**0.3 (0.2-0.4)**	**0.3 (0.2-0.5)**	**0.3 (0.2-0.5)**	**0.3 (0.2-0.5)**
Body mass index, kg/m^2				
< 25	1	1	1	1
25-29.9	0.7 (0.4-1.1)	0.6 (0.3-1.0)	1.4 (0.7-3.0)	**0.4 (0.2-0.9)**
≥ 30	1.3 (0.9-1.8)	1.2 (0.8-1.9)	1.6 (0.8-3.5)	1.0 (0.6-1.5)
Smoking				
Never-smoker	1	1	1	1
Former smoker	1.3 (1.0-1.8)	1.2 (0.7-1.9)	0.9 (0.6-1.5)	1.4 (0.9-2.2)
Current smoker	**2.0 (1.2-3.2)**	**2.1 (1.3-3.6)**	**1.8 (1.1-3.1)**	**2.3 (1.4-4.0)**
Diabetes duration, y				
≤ 5	1	1		1
6-10	1.4 (0.9-2.1)	1.7 (1.0-2.8)		1.5 (0.9-2.4)
11-20	1.1 (0.8-1.7)	1.0 (0.6-1.8)		0.9 (0.5-1.5)
> 20	**2.1 (1.3-3.3)**	1.5 (0.9-2.3)		1.3 (0.7-2.3)

[a]Determined using stepwise model selection method with *P* value for entry as .15 and *P* value for stay as .20 among all the listed covariates, marital status, and insurance coverage; the covariates with an AOR are those selected. Each OR is adjusted for all of the selected covariates.
[b]All results are weighted. AORs in bold indicate statistical significance at $\alpha = 0.05$ level.

Discussion

The primary purpose of this study was to examine the potential racial/ethnic disparities of HRQOL and its key risk factors among US adults with self-reported diabetes. The adjusted analyses show that Hispanics with diabetes were significantly less likely to report 14 or more mentally unhealthy days and activity-limited days compared to non-Hispanic whites, whereas the odds ratio of self-reported health status dropped below statistical significance after adjusting for the covariates. The HRQOL of non-Hispanic blacks with diabetes was not significantly different from that of non-Hispanic whites. Compared to the Hispanic patients, non-Hispanic whites and non-Hispanic blacks share more common influences on their HRQOL, especially 2 modifiable risk factors: smoking and BMI.

Compared to previous research on racial/ethnic disparities of HRQOL among individuals with diabetes, this

Table 4

Adjusted Odds Ratios (AORs) and 95% Confidence Intervals (CIs) for the Most Predictive Model[a] of Specific Health-Related Quality of Life Indices among Non-Hispanic Black Adults with Self-Reported Diabetes, National Health and Nutrition Examination Survey (NHANES) 2001-2010[b]

Characteristic	Health Status Fair/Poor AOR (95% CI)	≥ 14 Physically Unhealthy Days AOR (95% CI)	≥ 14 Mentally Unhealthy Days AOR (95% CI)	≥ 14 Activity-Limited Days AOR (95% CI)
Age group, y				
20-49			1	
50-64			0.8 (0.5-1.4)	
≥ 65			**0.3 (0.2-0.4)**	
Sex				
Male			1	1
Female			**1.8 (1.2-2.6)**	1.5 (1.0-2.2)
Education				
Less than high school	1		1	
High school or equivalent	**0.5 (0.4-0.8)**		**0.4 (0.2-0.7)**	
College or above	0.7 (0.5-1.0)		0.9 (0.6-1.6)	
Family poverty–income ratio				
< 1.3	1	1	1	1
1.3-3.5	**0.6 (0.4-1.0)**	0.7 (0.5-1.0)	0.8 (0.5-1.2)	**0.6 (0.4-0.9)**
> 3.5	**0.3 (0.2-0.6)**	**0.3 (0.2-0.5)**	0.6 (0.3-1.1)	**0.3 (0.1-0.5)**
Body mass index, kg/m^2				
< 25	1	1		
25-29.9	1.1 (0.7-1.8)	1.6 (0.8-3.2)		
≥ 30	**2.1 (1.3-3.6)**	**2.7 (1.4-5.4)**		
Smoking				
Never-smoker	1	1	1	1
Former smoker	0.9 (0.6-1.4)	1.3 (0.9-2.1)	1.1 (0.6-2.1)	1.2 (0.7-2.0)
Current smoker	1.0 (0.7-1.6)	**1.8 (1.1-3.0)**	**2.1 (1.2-3.7)**	**2.2 (1.2-4.0)**
Insurance coverage				
Yes	1			
No	**2.0 (1.3-3.1)**			

[a]Determined using stepwise model selection method with *P* value for entry as .15 and *P* value for stay as .20 among all the listed covariates, marital status, and diabetes duration; the covariates with an AOR are those selected. Each OR is adjusted for all of the selected covariates.
[b]All results are weighted. AORs in bold indicate statistical significance at $\alpha = 0.05$ level.

study applied a different HRQOL measurement, the CDC HRQOL-4, in a nationally representative sample. The current study looked at differences only among Hispanics, non-Hispanic whites, and non-Hispanic blacks. This study yielded results similar to those of the study by Quandt et al,[13] where older non-Hispanic black patients with diabetes did not report significantly different physical or mental health compared to whites. In the other study by Laiteerapong et al,[14] ethnic minorities including Hispanics had significantly better physical health but no significant difference in mental health. Laiteerapong et al[14] suggested that the counter-intuitive ethnic patterns in HRQOL (whites having lower HRQOL than ethnic minorities) could be due to the uniform access to care within integrated health care delivery systems of all study participants with different races/ethnicities. However, in the present study, ethnic minorities also reported better HRQOL even though not all of the participants have the same access to health care.

Some studies investigated racial/ethnic disparities in HRQOL (assessed with CDC HRQOL measures) among patients with other chronic diseases, such as coronary

Table 5

Adjusted Odds Ratios (AORs) and 95% Confidence Intervals (CIs) for the Most Predictive Model[a] of Specific Health-Related Quality of Life Indices among Hispanic Adults with Self-Reported Diabetes, National Health and Nutrition Examination Survey (NHANES) 2001-2010[b]

Characteristic	Health Status Fair/Poor AOR (95% CI)	≥ 14 Physically Unhealthy Days AOR (95% CI)	≥ 14 Mentally Unhealthy Days AOR (95% CI)	≥ 14 Activity-Limited Days AOR (95% CI)
Age group, y				
20-49	1	1		
50-64	**2.1 (1.4-3.1)**	**2.5 (1.5-4.0)**		
≥ 65	**2.3 (1.4-3.8)**	**2.3 (1.4-3.8)**		
Sex				
Male		1	1	
Female		**1.9 (1.3-2.7)**	**1.8 (1.1-2.8)**	
Education				
Less than high school	1		1	
High school or equivalent	**0.5 (0.3-0.8)**		**2.9 (1.7-5.0)**	
College or above	**0.3 (0.2-0.5)**		0.8 (0.5-1.3)	
Marital status				
Married/living with partner		1	1	
Never married		**0.5 (0.3-0.8)**	0.4 (0.1-1.3)	
Divorced/widowed/separated		1.6 (1.0-2.4)	**1.7 (1.1-2.7)**	
Family poverty–income ratio				
< 1.3	1		1	1
1.3-3.5	0.8 (0.6-1.2)		1.0 (0.6-1.7)	0.7 (0.4-1.3)
> 3.5	**0.4 (0.3-0.7)**		**0.3 (0.1-0.5)**	**0.2 (0.1-0.9)**
Insurance coverage				
Yes	1		1	
No	**2.4 (1.5-3.8)**		**1.6 (1.1-2.6)**	
Diabetes duration, y				
≤ 5	1			
6-10	1.5 (0.9-2.4)			
11-20	**2.6 (1.7-4.0)**			
> 20	**2.3 (1.5-3.4)**			

[a]Determined using stepwise model selection method with *P* value for entry as .15 and *P* value for stay as .20 among all the listed covariates, smoking status, and body mass index; the covariates with an AOR are those selected. Each OR is adjusted for all of the selected covariates.
[b]All results are weighted. AORs in bold indicate statistical significance at $\alpha = 0.05$ level.

heart disease (CHD) and arthritis,[25,26] and yielded patterns in HRQOL very similar to those observed in the current study. In a study by Hayes et al,[25] Hispanic CHD patients were significantly more likely to report poor/fair health status but less likely to report 14 or more activity-limited days, whereas non-Hispanic black CHD patients did not report significantly different HRQOL compared to white CHD patients. Carpenter et al[26] found that Hispanics with arthritis were more likely to report fair/poor health status and less activity limitation than whites or blacks.

Previous research has already established some risk factors of HRQOL for patients with diabetes,[11,23] including age, sex, education, income, smoking, BMI, and diabetes duration. Consistent with previous findings, the present results also support a significant effect from these predictors on HRQOL for participants with diabetes, especially from the family PIR. Having a family PIR greater than 3.5 is associated with better HRQOL across all 4 domains in this study. Furthermore, it appears that the effects of these factors on HRQOL vary by race/ethnicity. Specifically,

lack of insurance coverage was a more significant predictor of poor/fair health status for black and Hispanic participants. This makes sense because individuals with a lack of health insurance often do not have regular checkups and wait until health problems are unmanageable before seeking care and paying the out-of-pocket medical expenses. Being a current smoker was a significant predictor of worse HRQOL among white and black participants. Body mass index was selected as a key factor for HRQOL only among whites and blacks but not Hispanics, which could be due to the different perception of BMI by race/ethnicity. McDonough et al[27] found that South Asian ethnicity significantly reduced the risk of having a low HRQOL when compared to West European ethnicity. However, no previous research investigated the potential differences in the influence of BMI on HRQOL among whites, blacks, and Hispanics.

The findings support that tailored interventions can be appropriate for patients with diabetes in different racial/ethnic groups to improve their HRQOL. As smoking is the top modifiable risk factor for chronic disease, an emphasis on quitting smoking appears to be particularly relevant to improve HRQOL among whites and blacks with diabetes. Overweight or obese black patients with diabetes had worse HRQOL compared to those of normal weight. Future studies should therefore investigate the specific risk factors associated with poor HRQOL among obese blacks with diabetes as well as explore interventions to decrease the prevalence of obesity among blacks with diabetes. Hispanic patients without insurance coverage or with longer diabetes duration appear particularly vulnerable to worse HRQOL and the prevalence of coverage is significantly lower, so arranging health care resources to increase the insurance coverage for minorities could be a powerful tool to further reduce the disparities in HRQOL among patients with diabetes. With the observed variations, this study lends more support to physicians inquiring about HRQOL and related factors with each patient rather than applying a standard set of recommendations centered on race/ethnicity to improve HRQOL.

This study has several strengths worth noting including the use of a nationally representative dataset with relatively large sample size. In addition, NHANES oversampled minorities, thus providing adequate sample size for the stratified analyses of black and Hispanic participants with self-reported diabetes.

The study is subject to some limitations. First, only the participants with self-reported diabetes were included in the current study. The reason for including only the self-reported patients is because the HRQOL is the self-perception of health status. It could vary greatly according to individuals' awareness of disease. No previous study investigated the difference in HRQOL among diagnosed and undiagnosed patients with diabetes, but 1 study found that undiagnosed hypertensive patients have significantly better HRQOL, specifically general health and physical function, compared to diagnosed hypertensive patients.[28] The HRQOL of individuals with diagnosed or undiagnosed diabetes could thus differ substantially and should be evaluated separately. Future studies should investigate the HRQOL and associated risk factors of people with undiagnosed diabetes and determine how they differ from diagnosed patients. Second, only 3 races/ethnicities were investigated in the study due to the categorization of race/ethnicity in the NHANES questionnaire and numerical limitations for minorities who were not oversampled. It is possible that other minor racial/ethnic groups such as Asian and Native American may have differences in HRQOL but were unable to be evaluated. However, the racial/ethnic groups included are those that make up most of the US population. The analysis also does not control for the severity of diabetes, including factors such as glycohemoglobin (HbA1C) level and the presence of complications of diabetes. However, diabetes duration has been adjusted for in the study, which would presumably be highly correlated with the other variables indicating the severity of diabetes. Finally, these NHANES data are cross-sectional, so they cannot be used to establish a causal relationship since the change of diabetic patients' HRQOL over time cannot be assessed in this study.

Implications

In summary, these findings suggest the importance of individualized interventions for patients with diabetes since racial/ethnic disparities of HRQOL were observed for US adults with self-reported diabetes. Different key factors for HRQOL by race/ethnicity also indicate that different emphases in the patient care for each race/ethnicity are necessary. For example, smoking and increased BMI were identified as 2 significant indicators of poor HRQOL among non-Hispanic whites and blacks with diabetes. Educators and providers could encourage smoking cessation and weight control especially in these populations. Lack of insurance coverage is a key element of worse self-rated health status or

mental health among blacks and Hispanics, which implies that improved health care accessibility could be a useful tool to improve HRQOL among minorities. In addition, Hispanic patients who were divorced, widowed, or separated deserve more attention given their poorer reported physical and mental health. Overall, to achieve better management of diabetes, communication between patients and health care providers needs to include assessing individual quality-of-life factors that can be variable or similar across races, culture, and sex. Building interventions taking into account individual characteristics and key contributing factors may constitute an important tool to improve the HRQOL of individuals with diabetes.

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